

# USGS/DWR Concurrent Missions and an application of Watershed Modeling

*Kate Koczot USGS San Diego CA*

*[kmkoczot@usgs.gov](mailto:kmkoczot@usgs.gov)*



# OUTLINE

- Review Mission Statements
- Ongoing PRMS models and Supporting Software
- Current Applications
  - Real-time simulations/Forecasting
  - Decision Support System for Reservoir Operations
  - Climate Change
- Future Statewide Applications
- Present and Future Data from CAWSC
- Future National Work

**CA DWR Mission:** To manage the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments.

**USGS Mission:** Serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

**CAWSC Mission:** Within the framework of the USGS mission, in cooperation with local, State, and other Federal agencies, collects, interprets, and provides unbiased and timely scientific information of the highest quality for the responsible planning, use, and management of California's water resources.

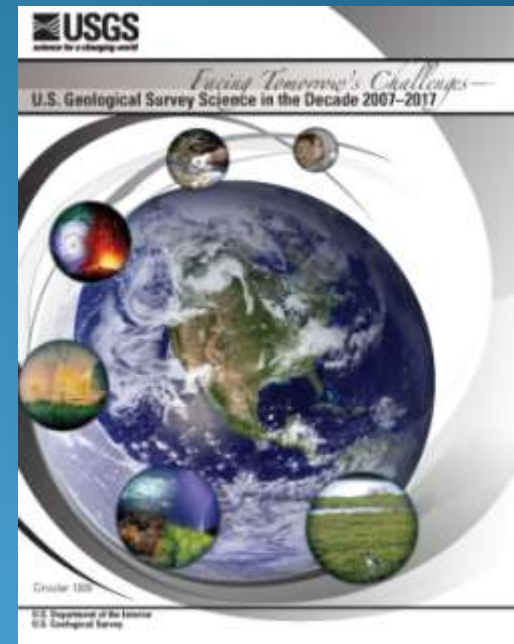
# USGS Science Directions 2007-2017

- Understanding Ecosystems and Predicting Ecosystem Change
- Climate Variability and Change
- Energy and Minerals for Americas Future
- Natural Hazards Risk and Resilience Assessment Program
- Role of Environment and wildlife in Human Health
- Water Census of the United States.



# Development new understanding: Systems Approach

- Data Integration and Beyond
- Leveraging Evolving Technologies



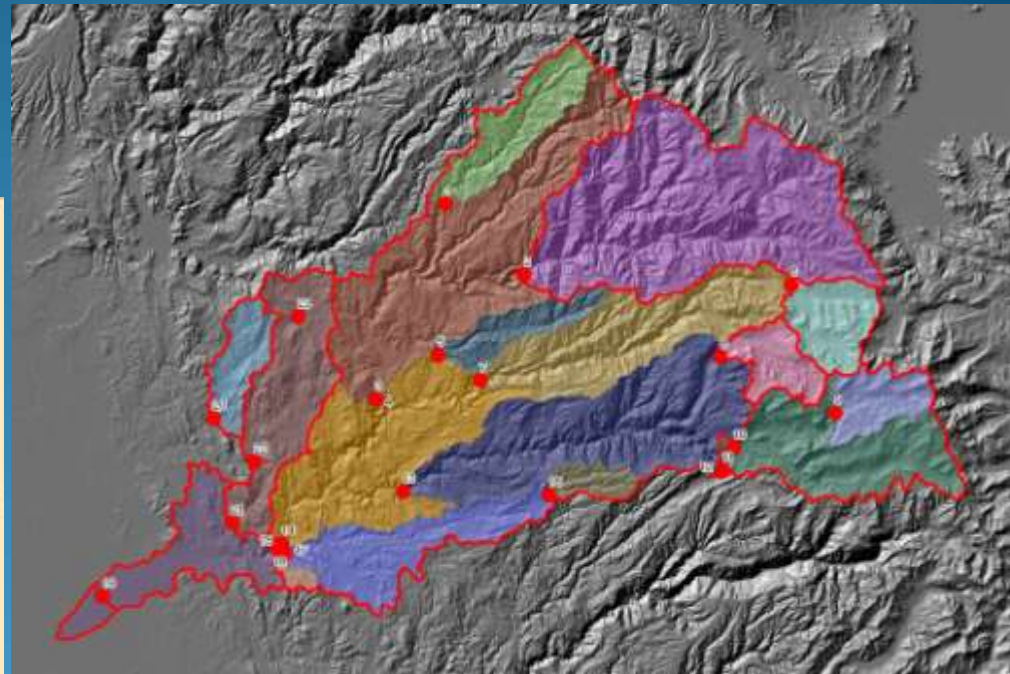
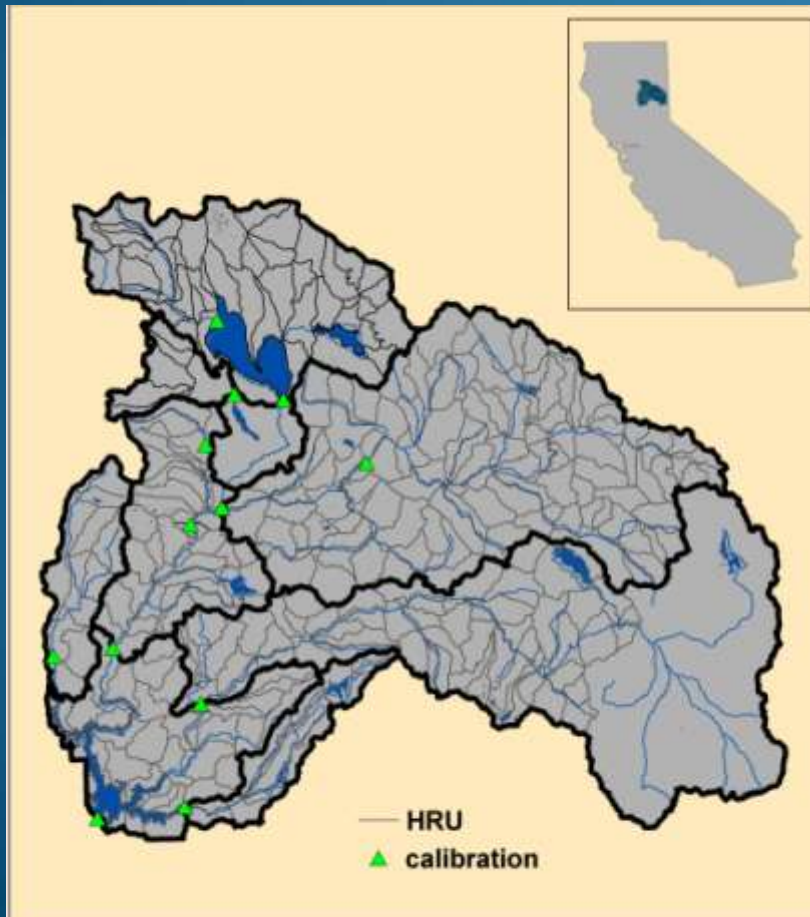
# Shared Goals and Research Interests

- Stream forecasting
- Climate change
- Water resources management
- Flood mitigation
- Protection and enhancement of natural and human environments



# Ongoing PRMS Models

Feather PRMS



Yuba PRMS

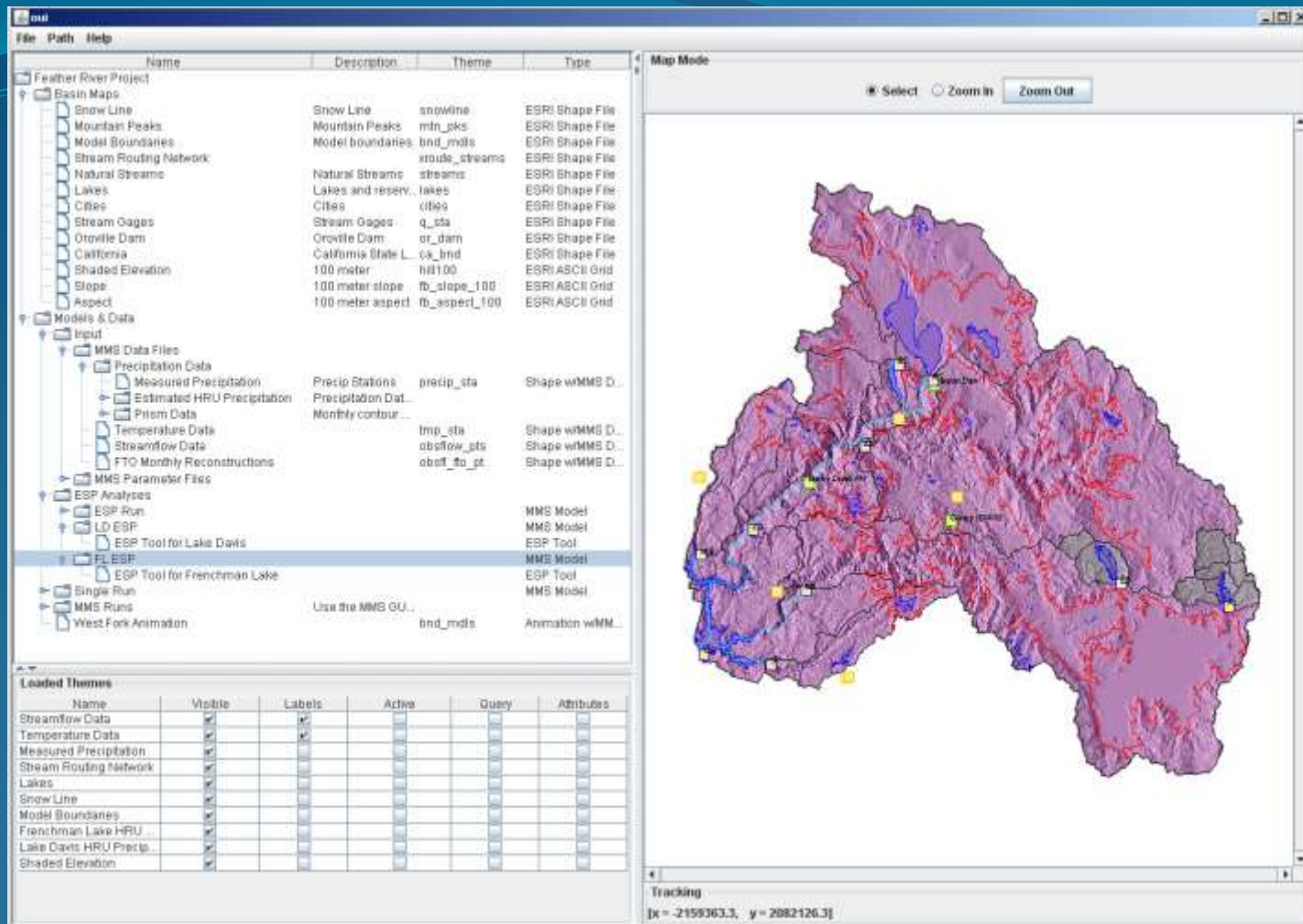
- Yuba improving based on knowledge and experience gained in Feather.

# PRMS supporting tools from NRP Developers

[http://wwwbrr.cr.usgs.gov/projects/SW\\_MoWS/index.shtml](http://wwwbrr.cr.usgs.gov/projects/SW_MoWS/index.shtml)

- Object User Interface (OUI)
- DOWNSIZER (climate and stream gage daily data retrieval tool).





# PRMS Object User Interface (OUI)

## (PRMS, ESP, xRoute, MMI, DMI)

[http://wwwbrr.cr.usgs.gov/projects/SW\\_MoWS/software/oui\\_and\\_mms\\_s/oui.shtml](http://wwwbrr.cr.usgs.gov/projects/SW_MoWS/software/oui_and_mms_s/oui.shtml)



# DOWNSizer: PRMS Compatible Format

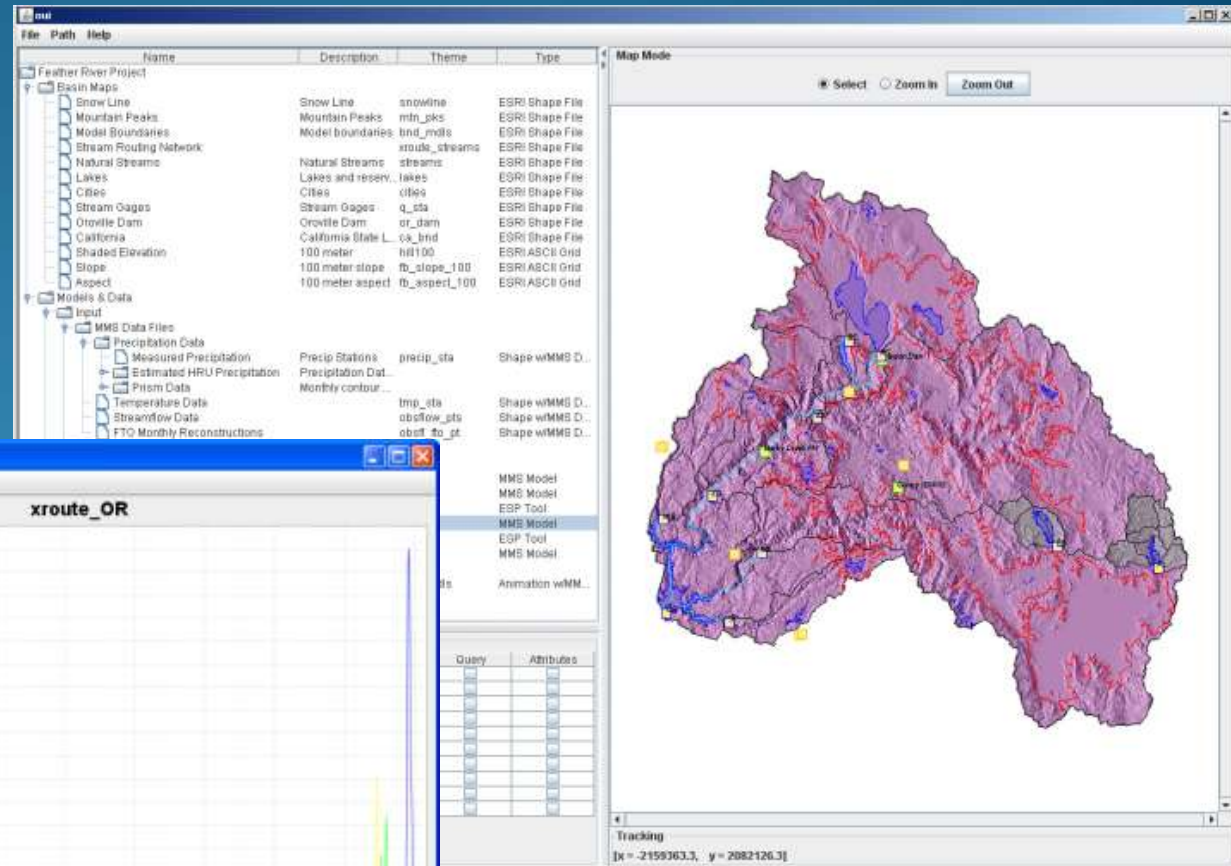
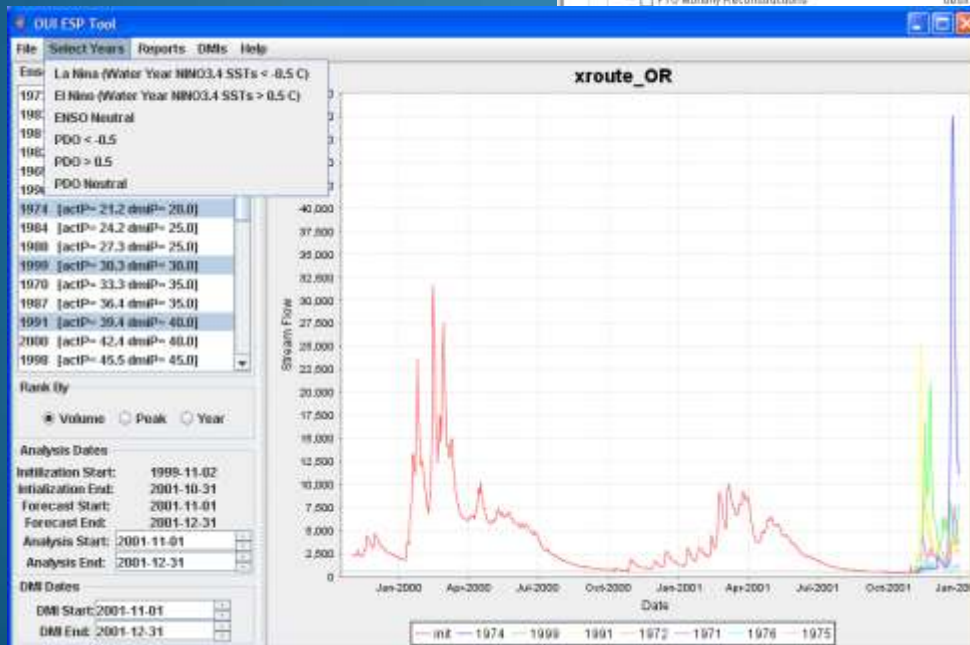
Source: NWS Coop network, NRCS SNOTEL network, USGS NWIS network

[http://www.brr.cr.usgs.gov/projects/SW\\_MoWS/software/downsizer\\_s/downsizer.shtml](http://www.brr.cr.usgs.gov/projects/SW_MoWS/software/downsizer_s/downsizer.shtml)

# Current Applications

# Application: Forecasting (ESP)

- ESP forecasts are made for established nodes along the routing path.
- Or, Real-time simulation mode for same nodes along the routing path

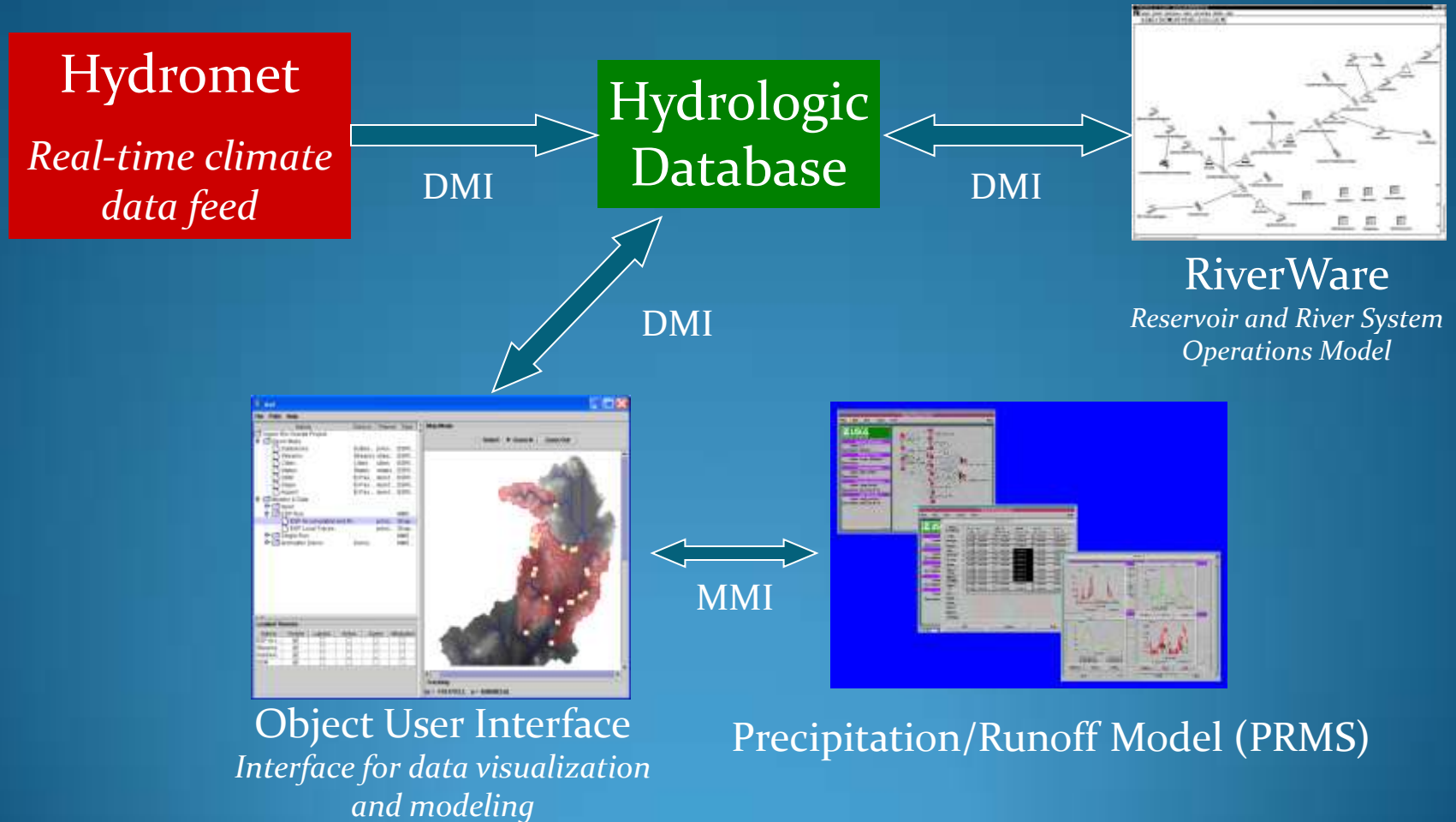




# Application: USGS/BOR Decision Support System

By Markstrom, King and Davidson

[ftp://brrftp.cr.usgs.gov/pub/markstro/markstrom\\_awra.pdf](ftp://brrftp.cr.usgs.gov/pub/markstro/markstrom_awra.pdf)



# Application: Feather Climate change study (NRP/CAWSC)



## WATERSHED-SCALE RESPONSE TO CLIMATE CHANGE: FEATHER RIVER BASIN, CALIFORNIA

*Kathryn Koczot (CAWSC), Lauren Hay, and Steven Markstrom, as part of*

## Integrated watershed scale response to global change in selected basins across the United States

*Lauren Hay and Steven Markstrom*

U.S. Geological Survey, National Research Program, Modeling of Watershed Systems, Denver, Colorado



# Climate-Change Study Objectives

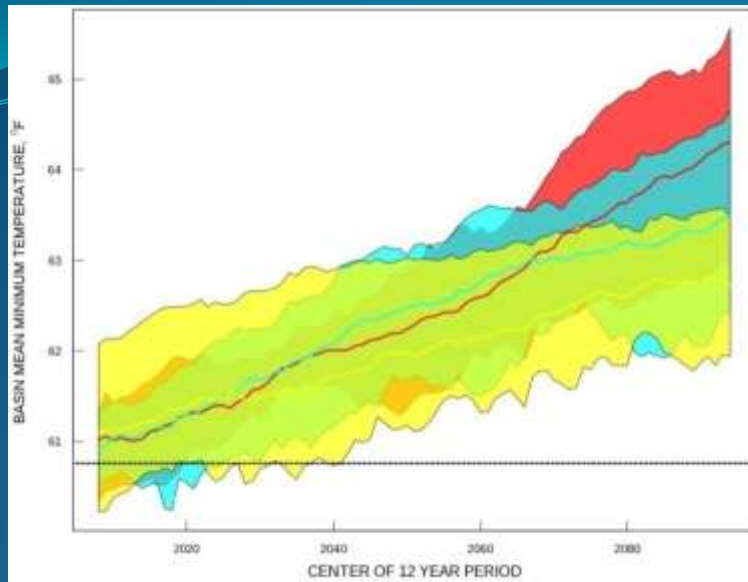
- Determine the sensitivity and potential impact of long-term climate change on the fresh water resources of the USA.
- Provide the foundation for hydrologically based climate-change studies across the nation.



# Climate-Change Study Methods

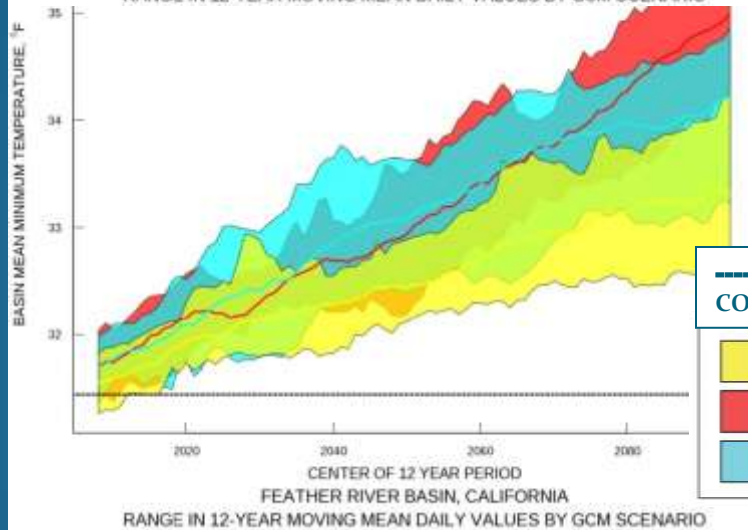
- Output from 6 GCMs and three GCM scenarios were used to develop an ensemble of climate-change scenarios (2001-2099).
- Ensembles were simulated with corresponding PRMS model.
- Forecast simulations were compared to current conditions (1988-1999).

Tmax



FEATHER RIVER BASIN, CALIFORNIA  
RANGE IN 12-YEAR MOVING MEAN DAILY VALUES BY GCM SCENARIO

Tmin



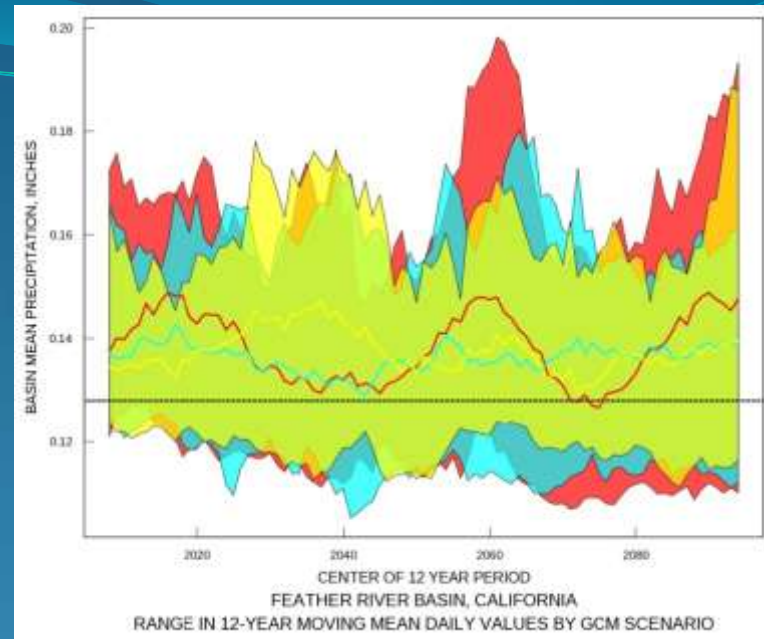
FEATHER RIVER BASIN, CALIFORNIA  
RANGE IN 12-YEAR MOVING MEAN DAILY VALUES BY GCM SCENARIO

— CURRENT  
CONDITIONS (1988-1999)

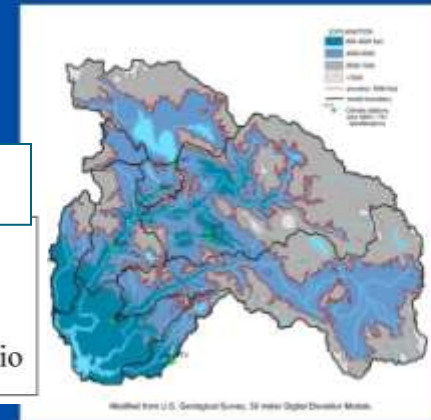
SRSB1 Scenario

SRSa2 Scenario

SRESa1b Scenario



PPT



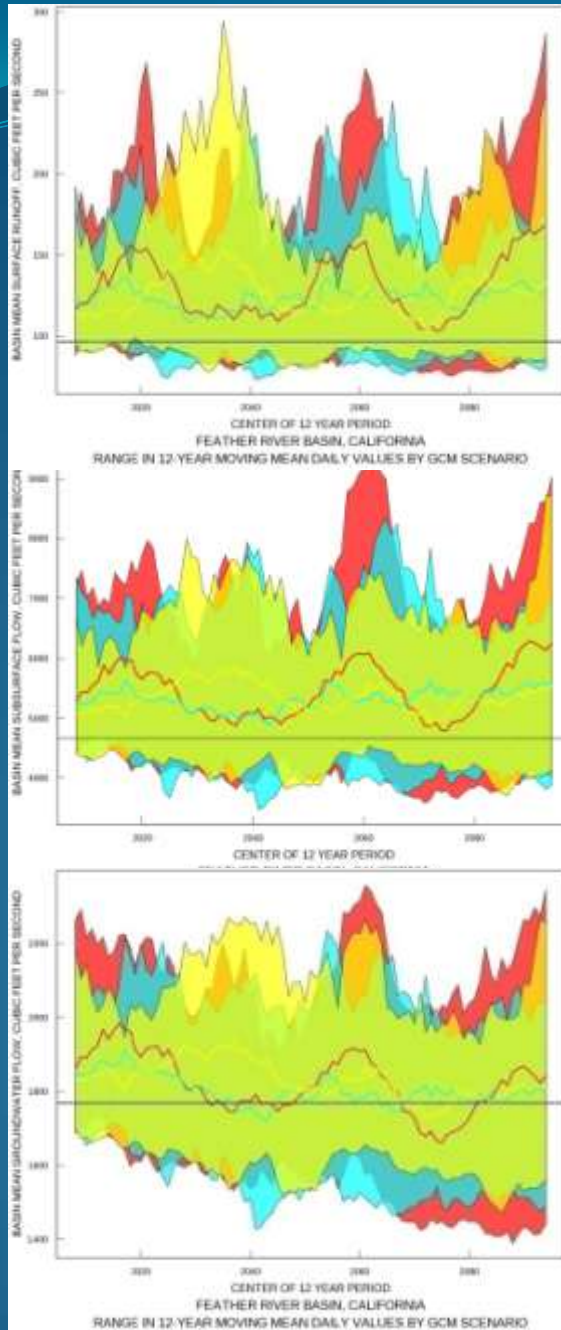
# GCM Data input in Feather PRMS



SR  
2.3%

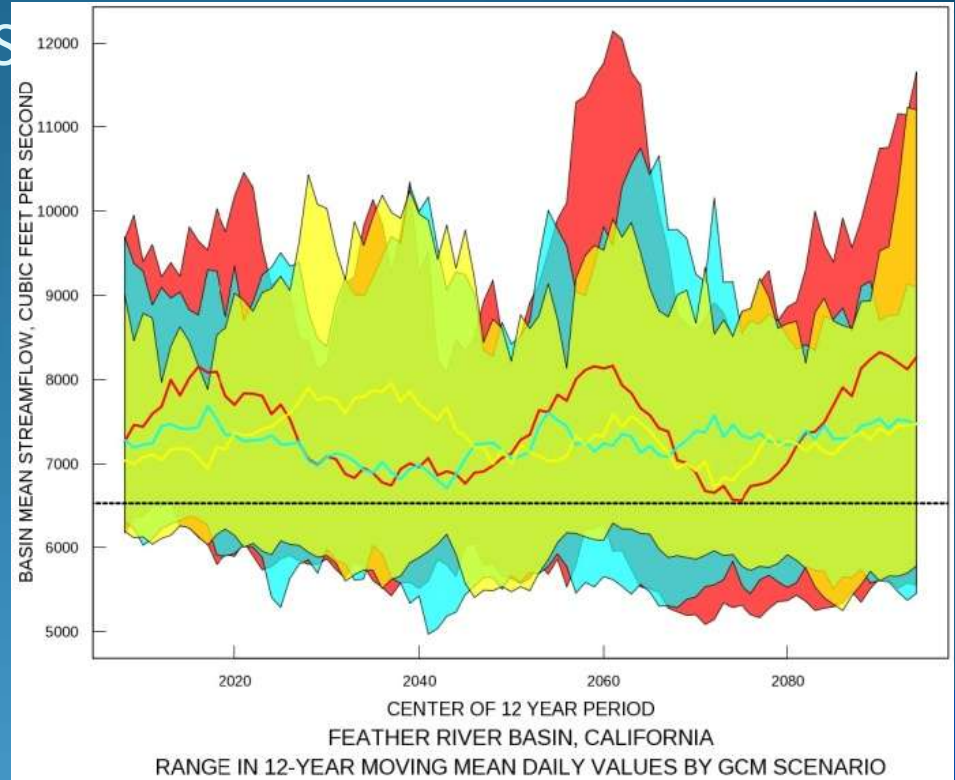
SSR  
72.4%

GW  
25.3%



## Streamflow and Components of Flow:

R, SS

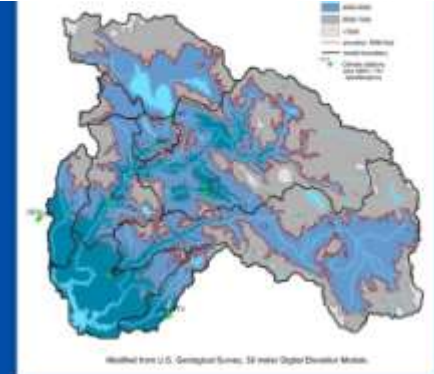


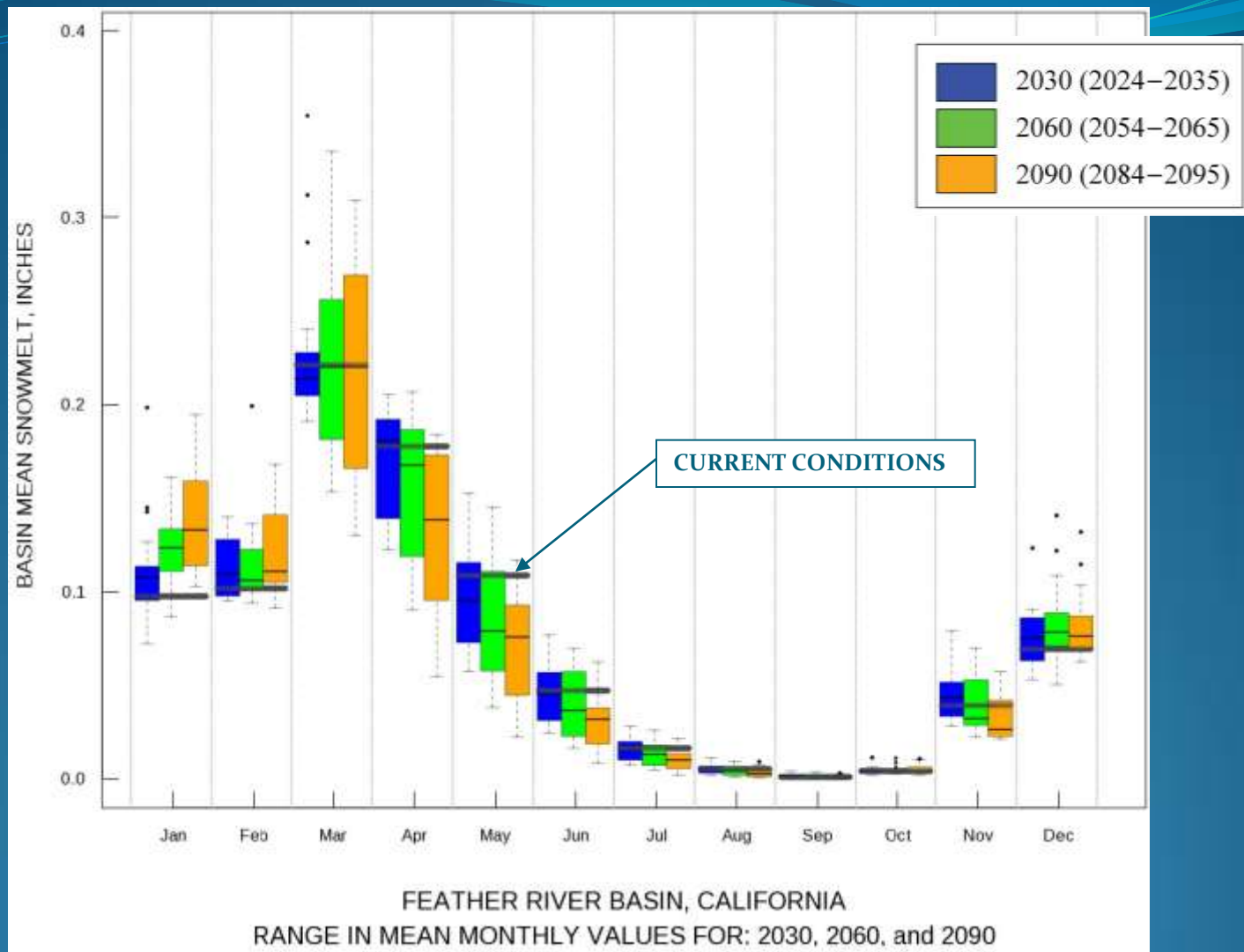
### —CURRENT CONDITIONS (WY1988-1999)

 SRSB1 Scenario

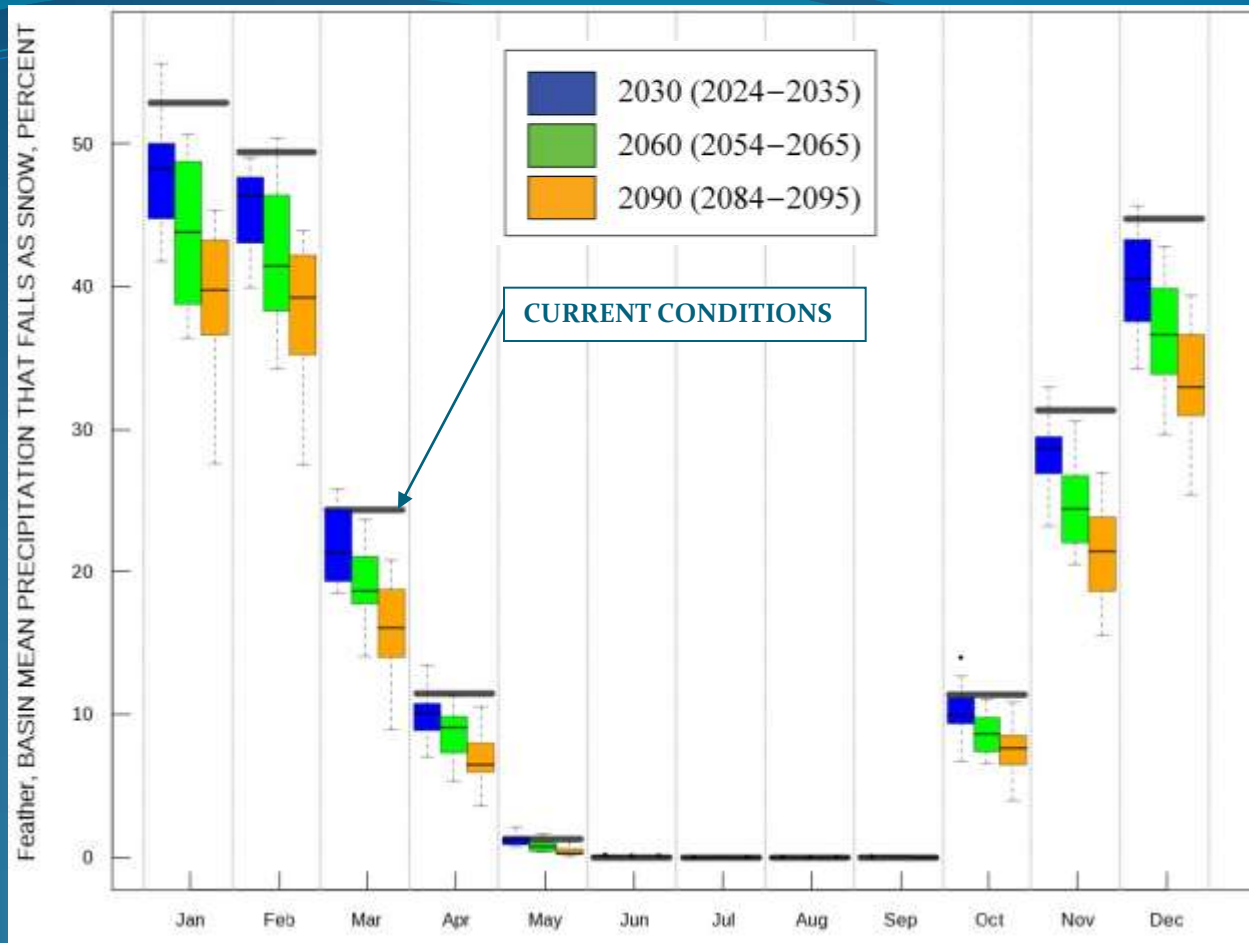
 SRSa2 Scenario

■ SRESa1b Scenario

Modified from U.S. Government Survey, 50 miles (80 km) from Mexico



# Basin Mean Snowmelt by Month



# Percentage of Precipitation that Falls as Snow by Month



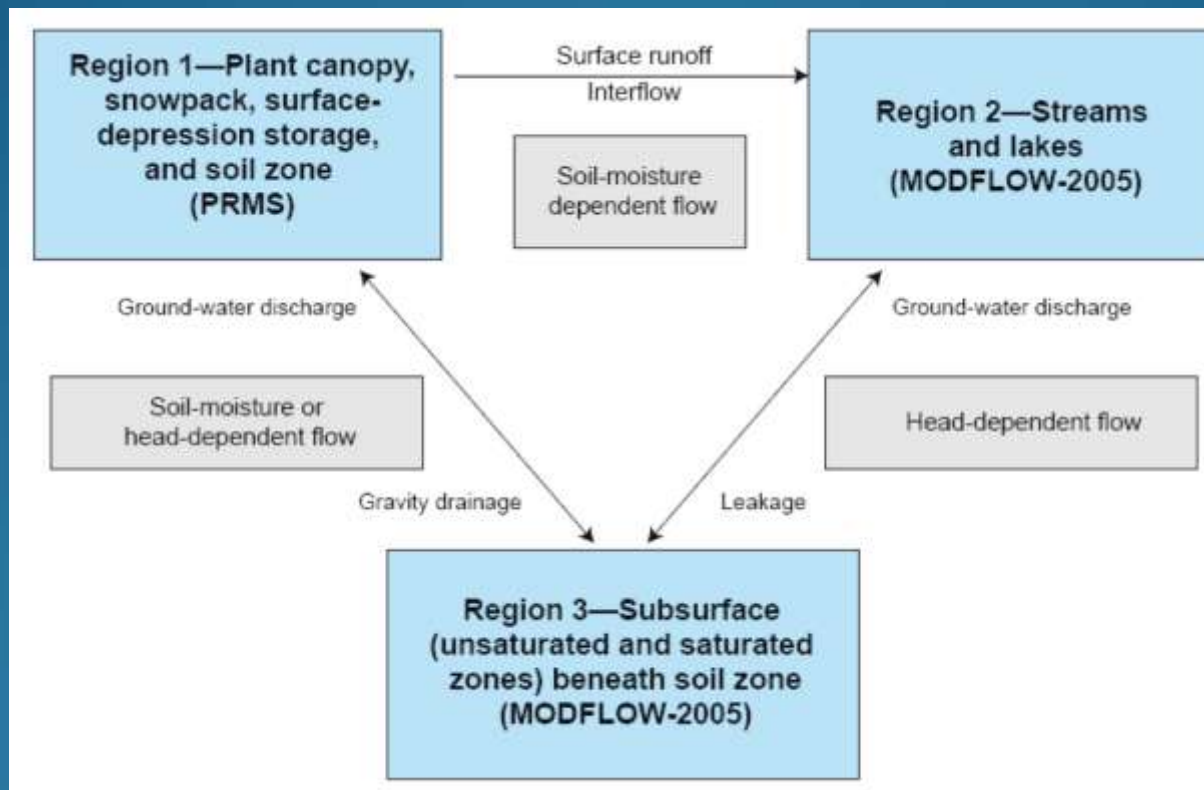
# Implications for Changes in Watershed Management

- Water availability in summer for the SWP.
- Hydropower production.
- Winter high flows.
- Water quality and quantity for fisheries.
- Reservoir Operations at Lake Oroville.

# Future Statewide Applications:

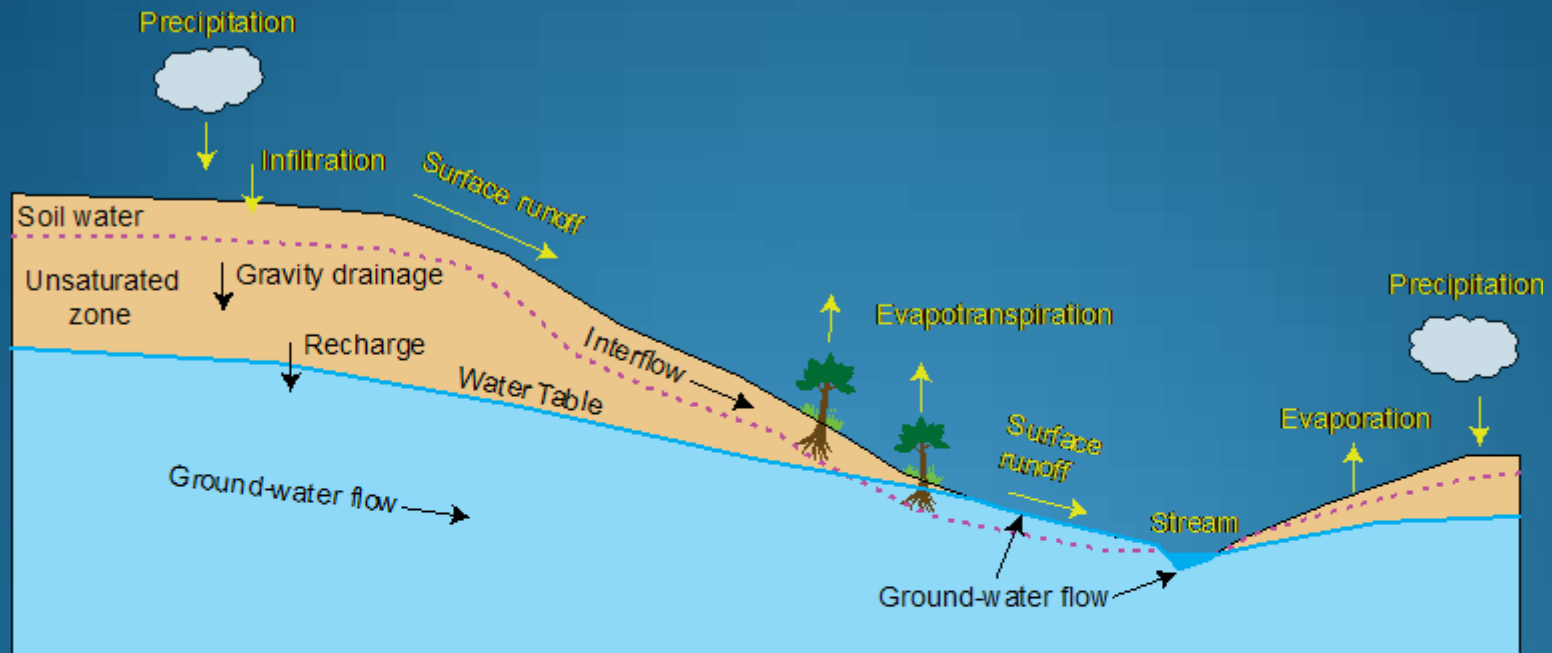
- GSFLOW
- Central Valley Model

# GSFLOW: Region Connections Between PRMS and MODFLOW



[http://wwwbrr.cr.usgs.gov/projects/SW\\_MoWS/software/gsflow\\_s/gsflow.shtml/](http://wwwbrr.cr.usgs.gov/projects/SW_MoWS/software/gsflow_s/gsflow.shtml/)

# GSFLOW CONCEPTUAL MODEL



## EXPLANATION

- Zone of aeration
- Zone of saturation
- Base of soil zone

# GSFLOW UTILITY

- Simulate climate and land-cover change
- Simulate storage in snowpack
- Generate physically-based streamflow and recharge simulations for GW model
- Generate better saturated and unsaturated ground-water storage and fluxes for SW model

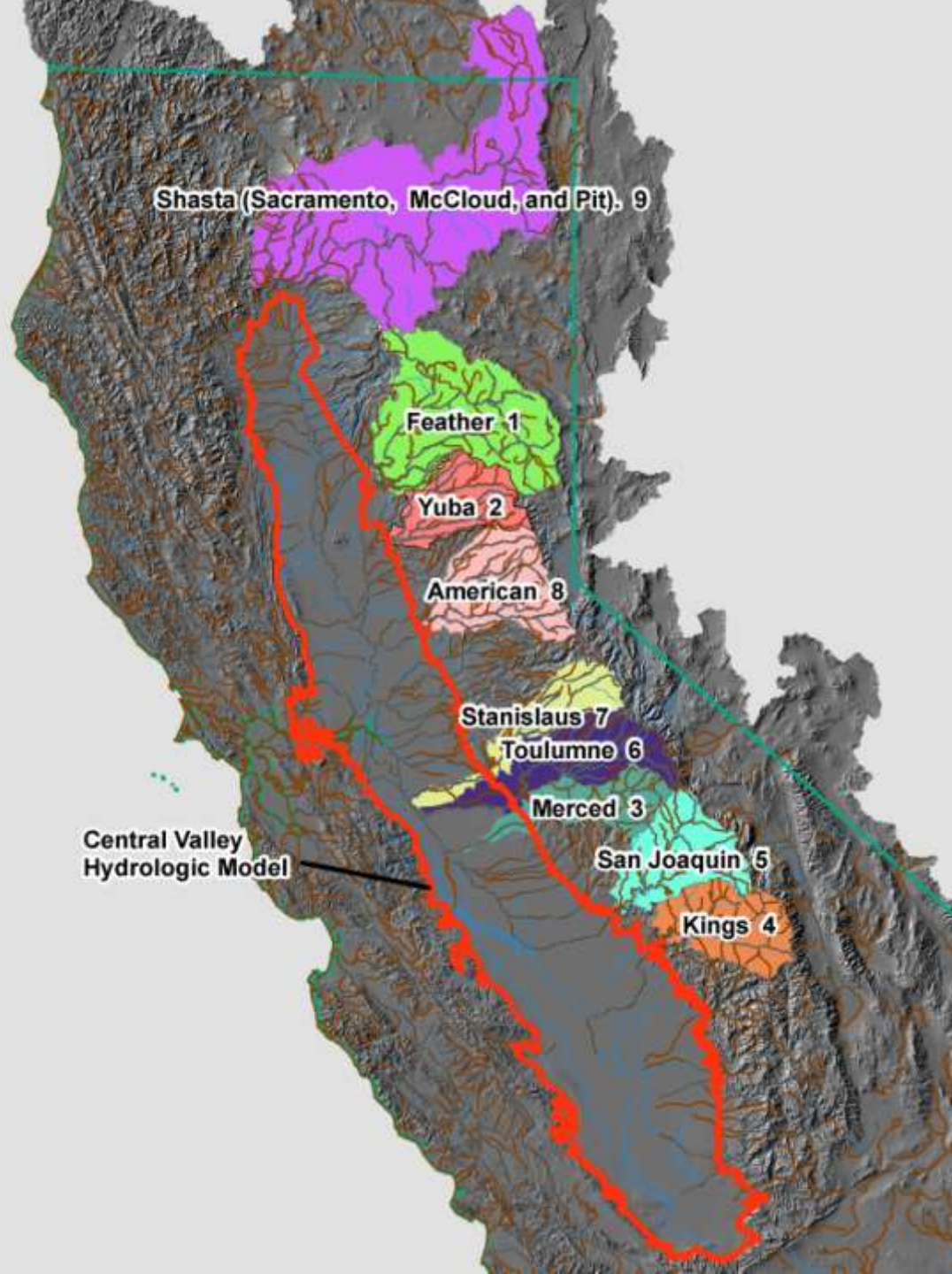


# Central Valley Model

(Reservoir Operations)

Claudia Faunt and  
Randy Hanson

<http://pubs.usgs.gov/fs/2009/3057/>





# Data from CAWSC

# USGS Water Data for the Nation, data back to the late 1880's <http://waterdata.usgs.gov/nwis> (Jim Bowers and Al Caldwell, CAWSC)

The screenshot shows the USGS National Water Information System: Web Interface. At the top is the USGS logo with the tagline "science for a changing world". Below the logo are links for "USGS Home", "Contact USGS", and "Search USGS". The main title is "National Water Information System: Web Interface". Below this are two dropdown menus: "Data Category:" with "Home" selected, and "Geographic Area:" with "United States" selected. There is a "GO" button next to the "Geographic Area" dropdown. Below the dropdowns is a link: "News New Mapper and Experimental Real-Time Web Service - updated August 2009". The main heading is "USGS Water Data for the Nation". Under this heading is a "Data Category" section with a list of categories: "Real-time data", "Site information", "Surface water", "Ground water", "Water quality", and "Mapper". Each category has a brief description. To the right of the "Data Category" section is an "Introduction" section with a paragraph of text. At the bottom of the page are three buttons: "About us", "Help", and "Tutorial".

**USGS**  
science for a changing world

USGS Home  
Contact USGS  
Search USGS  
National Water Information System: Web Interface

USGS Water Resources (District Access) Data Category: Home Geographic Area: United States GO

[News New Mapper and Experimental Real-Time Web Service](#) - updated August 2009

## USGS Water Data for the Nation

### Data Category

- Real-time data** Current-conditions data transmitted from selected surface-water, ground-water, and water-quality sites.
- Site information** Descriptive site information for all sites with links to all available water data for individual sites.
- Surface water** Water flow and levels in streams, lakes, and springs.
- Ground water** Water levels in wells.
- Water quality** Chemical and physical data for streams, lakes, springs, and wells.
- Mapper** Map of all sites with links to all available water data for individual sites.

### Introduction

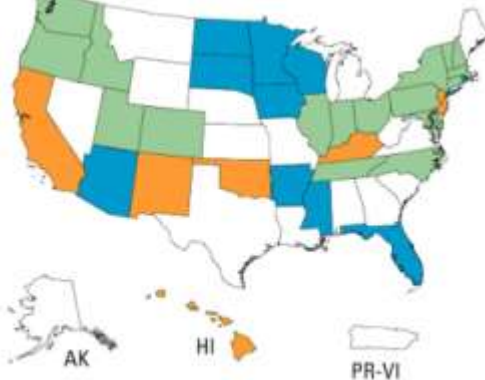
These pages provide access to water-resources data collected at approximately 1.5 million sites in all 50 States, the District of Columbia, and Puerto Rico. Online access to this data is organized around the categories listed to the left.

The USGS investigates the occurrence, quantity, quality, distribution, and movement of surface and underground waters and disseminates the data to the public, State and local governments, public and private utilities, and other Federal agencies involved with managing our water resources.

[About us](#) [Help](#) [Tutorial](#)

(CAWSC Data Retrieval Contact: Tom Haltom)

<http://water.usgs.gov/osw/streamstats/ssonline.html>



# Future National Work (NRP/WSC's)

Investigators: NRP-CO (Lauren Hay, Steve Markstrom), WIWSC, Woods Hole, Eastern Geographic Science Center, and Geospatial Information Office)

- Web Data Portal
  - (partially funded by GA).
- National Hydrologic Model Structure
  - nested models for data sharing and use by many scientists (already a gridded water-balance model).

# Future Work:

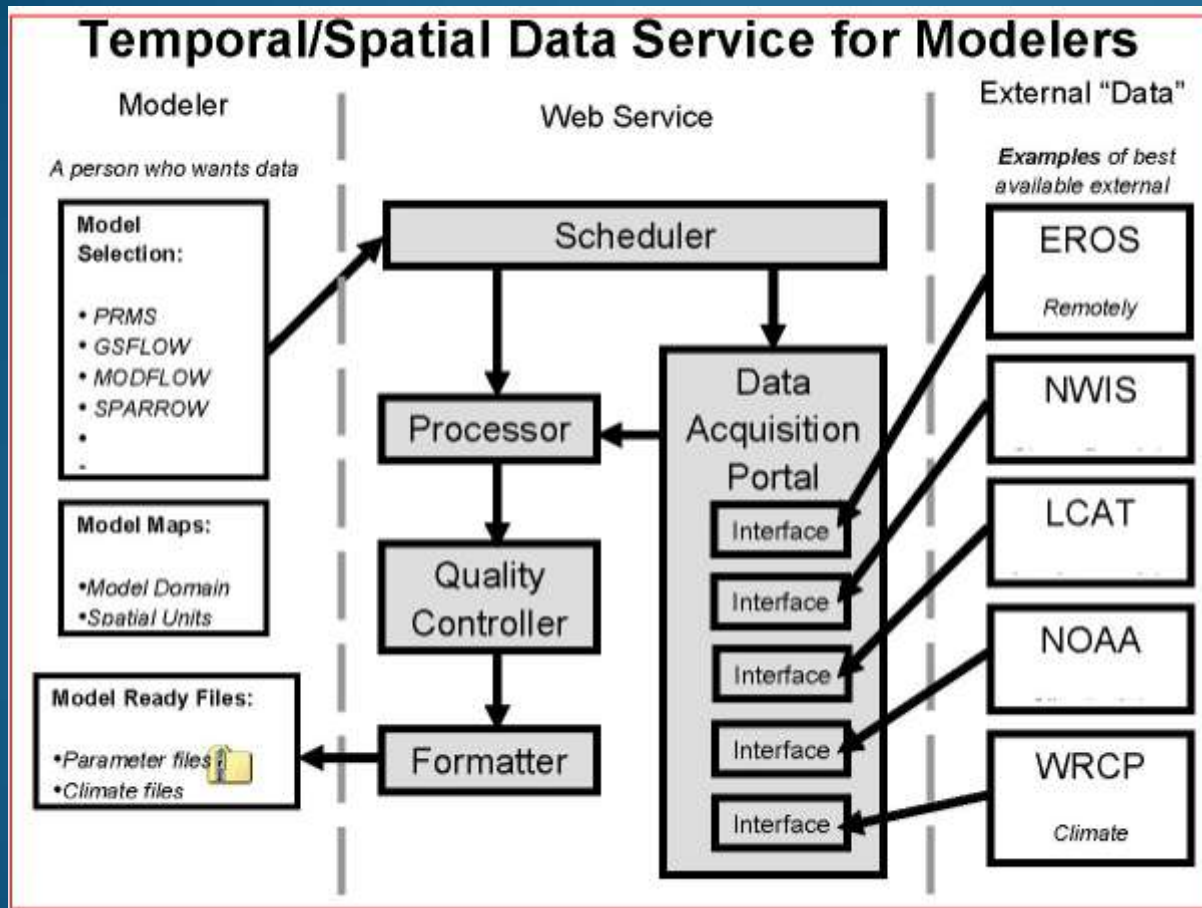
## WebData (or Desktop) Portal for Modeling

Use:

- Access to best available data
- Download previously developed models
- Loosely couple simulation models running at different spatial and temporal resolutions.

Modeler specifies:  
temporal and spatial  
resolution, and data  
type

Prototype: Georgia



# Future Work: National Hydrologic Model Structure

Approach

High Resolution



Fine Units  
Coarse Units

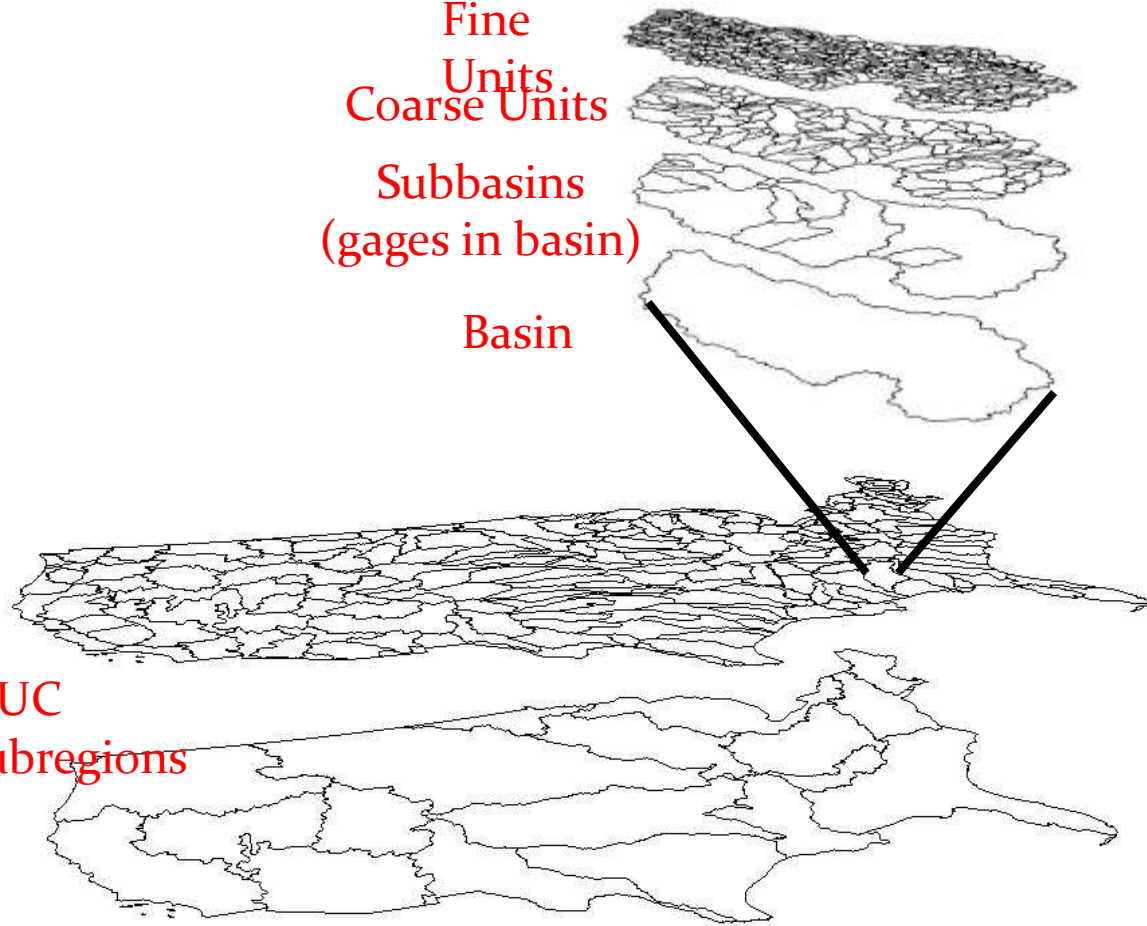
Subbasins  
(gages in basin)

Basin

HUC  
Subregions

Large Extent

HUC  
Regions





# References

- Feather SIR 2004-5202:  
<http://pubs.usgs.gov/sir/2004/5202/>
- Intergovernmental Panel on Climate Change, 2007,,  
Summary for policymakers, *in* Climate change 2007–The  
physical science basis, Contributions of Working Group 1  
to the Fourth Assessment Report of the Intergovernmental  
Panel on Climate Change: Cambridge University Press,  
Cambridge and New York, 18 p.
- Or visit the following Web sites:  
<http://wwwbrr.cr.usgs.gov/mows>
- [http://www.usgs.gov/global\\_change](http://www.usgs.gov/global_change)
- Central Valley model: <http://pubs.usgs.gov/fs/2009/3057/>

The background is a solid blue color with a subtle checkerboard pattern. At the top, there are several wavy, overlapping lines in shades of blue and teal, creating a dynamic, flowing effect.

# END SHOW

# GW/SW Studies Using GSFLOW

